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Research article

A Motivational Model of Physical Education and Links to Enjoyment, Knowledge, Performance, Total Physical Activity and Body Mass Index

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Abstract
The present paper examined the full sequence of the Hierarchical Model of Motivation in physical education (PE) including motivational climate, basic psychological needs, intrinsic motivation, and related links to contextual enjoyment, knowledge, performance, and total moderate to vigorous physical activity (MVPA). Gender differences and correlations with body mass index (BMI) were also analyzed. Cross-sectional data was represented by self-reports and objective assessments of 770 middle school students (52% of girls) in North-East Finland. The results showed that task-involving climate in girls' PE classes was related to enjoyment and knowledge through physical competence and intrinsic motivation, whereas task-involving climate was associated with enjoyment and knowledge via competence and autonomy, and total MVPA via autonomy, intrinsic motivation, and knowledge within boys. This may indicate that girls and boys perceive PE classes in a different way. Graded PE assessments appeared to be essential in motivating both girls and boys to participate in greater total MVPA, whereas BMI was negatively linked with competence and social relatedness only among girls. Although, the current and previous empirical findings supported task-involving teaching methods in PE, in some cases, ego-involving climate should be considered. Therefore, both task- and ego-involving teaching practices can be useful ways of developing preferred behaviors in PE classes.

Key words: Motivation, physical education assessment, school health, structural equation.

Introduction

Active living benefits health at all ages but is essential to the successful development of wellbeing in children and youth (World Health Organization, 2015). Since most young people in several Western, African, and Asian countries require more daily MVPA (Tremblay et al., 2016), there is a major need to promote physical activity. It is widely accepted that positive perceptions of physical competence, autonomy, and relatedness in school PE lead to higher intrinsic motivation and intentions to be physically active (Hagger, 2014; Ntoumanis, 2005; Vallerand and Lalande, 2011). Given that girls normally accumulate less MVPA than boys (Tremblay et al., 2016) and students with high BMI report lower perceptions of physical competence than students with lower BMI (Carissimi et al., 2017; Craft et al., 2003), more studies are needed to reveal relationships between girls' and boys' BMI and behavior in PE classes (Rauner et al., 2013). Additionally, less is known about associations between behavioral, affective, and cognitive outcomes in PE and overall MVPA (Ntoumanis, 2005). The present paper aimed to examine the links between motivational climate, basic psychological needs, intrinsic motivation, enjoyment, knowledge, and performance in PE, and total MVPA in addition to BMI and gender differences.

An integration of the Achievement Goal Theory (Nicholls, 1989), the Self-determination Theory (Deci and Ryan, 2017), and the Hierarchical Model of Motivation (Vallerand and Lalande, 2011), which has previously been successfully applied in PE contexts (Gråstén, 2014; Hagger, 2014; Ntoumanis, 2005; Standage et al., 2005), was used as a framework in the current study. Multi-theory models may allow researchers to comprehensively understand motivational processes in a way that a single perspective may not fully achieve (Hulleman et al., 2008). Specifically, the Achievement Goal Theory provides a framework to understand the relationships between the psychological environment and contextual outcomes in PE, whereas the Self-determination Theory focuses on the effects of PE classes on students' basic needs and motivation. Finally, the Hierarchical Model of Motivation captures the whole picture including social factors, psychological environment, and individual behavior in PE.

The Achievement Goal Theory postulates the motivational processes in PE, such as motivation is dependent on the motivational climate largely generated by teachers (Nicholls, 1989). Task-involving motivational climate relates to teaching structures that support effort and cooperation, and emphasize learning and self-referenced criteria for evaluation, whereas ego-involving motivational climate refers to learning situations that advance normative comparisons and competition (Ames, 1992). Previous research has revealed that task-involving climate in PE is positively related to perceived physical competence (Gråstén et al., 2012), intrinsic motivation (Yli-Piipari, 2011), importance of PE (Gråstén, 2016), PE enjoyment (Barkoukis et al., 2008), physical activity in PE (Bowler, 2009), and total physical activity (Ruch et al., 2012). In contrast, perceptions of an ego-involving climate in PE is either negligibly related or negatively related to similar outcomes (Gråstén et al., 2012; 2015). Previous findings have shown that girls perceived higher perceptions of a task-involving climate, whereas boys reported higher perceptions of an ego-involving climate in PE classes (Moreno-Murcia et al., 2011).

The Self-determination Theory (Deci and Ryan, 2017) outlines that intrinsically motivated young people are more likely to perceive their physical activity experiences as positive, and further, to be physically active.

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The development and functioning of intrinsic motivation are specified using the concept of basic psychological needs, namely competence, autonomy and social relatedness. Physical competence refers to one's beliefs about ability and the need to interact effectively with the environment to attain successfully valued outcomes (Deci and Ryan, 2017). In other words, if students are allowed to exercise at their own skill level in PE, they are more likely to feel competent (Alderman et al., 2006). According to previous studies, perceived physical competence has consistently been linked with intrinsic motivation (Deci and Ryan, 2017; Standage et al., 2005), enjoyment in PE (Fairclough, 2003; Gråstén et al., 2012), and self-reported physical activity (Cox et al., 2008; Yli-Piipari, 2011). Typically, boys score higher than girls in physical competence (Fairclough, 2003) and students with high BMI may have lower perceptions of physical competence (Craft et al., 2003).

Autonomy is the desire to influence one's own behavior and to achieve consistency between the particular activity and sense of self-determination (Deci and Ryan, 2017). In school PE, students who feel that they have more activities to choose from, are more likely to be physically active than if they are forced to participate in a single activity (Alderman et al., 2006). PE teachers should promote class structures that support autonomy, since this facilitates the development of self-determined motivation in PE classes (Standage et al., 2005) and physical activity (Standage et al., 2005). In a large Finnish study of Grade 9 students, boys scored higher than girls did on perceived autonomy in PE (Soini et al., 2007).

Relatedness represents the need to feel connected and to perceive acceptance from other people (Baumeister and Leary, 1995). Standage, Duda, and Ntoumanis (2005) concluded that although the peer group clearly has the potential to impact on students' motivation, the role of social relatedness in PE is widely unknown. Students may engage in physical activities, because they want to avoid being isolated from a group (Standage et al., 2005). PE classes which support students' perceived social relatedness, predict the likelihood of PE enjoyment (Cox et al., 2008) and physical activity engagement (Cox et al., 2008; Standage et al., 2005; Taylor et al., 2010). However, several studies have found competence to be the strongest predictor of intrinsic motivation compared with autonomy and relatedness in the domain of PE (Standage et al., 2005; Taylor et al., 2010).

Based on the Self-determination Theory, human behavior can be intrinsically motivated, extrinsically motivated, or amotivated. The regulation of motivation reflects a continuum, comprising different levels of self-determination, from intrinsic motivation to amotivation (Deci and Ryan, 2017). The types of motivation differ in their degree of relative autonomy (Deci and Ryan, 2017). The most essential element is intrinsic motivation, which refers to motivation that comes from inside an individual. For instance, an intrinsically motivated student participates in activity for interest and enjoyment without external obligations (Deci and Ryan, 2017). By contrast, extrinsic motivation refers to motivation that comes from outside. In the context of PE, this would be akin to performing better than other students perform. These rewards provide satisfaction and pleasure that the task itself may not provide (Deci and Ryan, 2017). Amotivation is defined as a state of lacking any motivation to engage in an activity or perform activities without purpose (Deci and Ryan, 2017). In a Finnish study of middle school students, boys scored higher on instrinsic motivation than girls in PE context (Yli-Piipari, 2011). The present study focused on intrinsic motivation, since it has been considered as the most essential dimension of exercise motivation (Deci and Ryan, 2017; Hagger, 2014; Yli-Piipari, 2011).

The central assumption of the Hierarchical Model of Motivation (Vallerand and Lalande, 2011) is that social factors (e.g. task-involving motivational climate) are positively associated with basic psychological needs (competence, autonomy, relatedness) and intrinsic motivation. Further, intrinsic motivation relates to contextual consequences that can be cognitive (e.g., knowledge), affective (e.g., enjoyment), and behavioral (e.g., performance in PE, MVPA) (Deci and Ryan, 2017; Vallerand and Lalande, 2011). Specifically, cognitive outcomes refer to the mental process of knowing, including aspects of awareness, reasoning, judgement (Deci and Ryan, 2017; Vallerand and Lalande, 2011) or giving a value (Eccles et al., 1984). Cognitions as contextual outcomes are largely unknown, since more studies with a larger number of contextual units are needed (Ntoumanis, 2005). Affective outcomes comprise, for instance, effort (Ntoumanis, 2005), enjoyment (Gråstén et al., 2012), and intention to be physically active in leisure time (Hagger, 2014; Standage et al., 2005). Behavioral outcomes such as physical activity participation have been widely studied with boys being more physically active than girls (e.g. Lonsdale et al., 2009; Yli-Piipari, 2011). However, the full sequence of a Hierarchical Model of Motivation including all types of contextual outcomes in PE classes has not been empirically tested.

To date, previous research has consistently showed decreasing levels of MVPA, especially in early adolescence (Tremblay et al., 2016) and the positive role of social factors mediated by basic needs satisfaction and intrinsic motivation in relation to positive consequences in school PE (Hagger, 2014; Ntoumanis, 2005; Vallerand and Lalande, 2011). Less is known, how motivation is linked with PE enjoyment, knowledge, performance, and total MVPA engagement. In addition, a limited set of studies considering the interrelationships of PE motivation and BMI have been reported (Rauner et al., 2013). Therefore, more corroborating evidence is needed to provide support for the role that motivation in PE has on behavior (Hagger, 2014; Ntoumanis, 2005; Vallerand and Lalande, 2011) and to reveal relationships between overweight and behavior in PE classes (Rauner et al., 2013). The present study elucidates the previous findings by adopting the full sequence of a Hierarchical Model of Motivation that considers BMI and gender differences.

The aims of the present study were to examine 1) direct relationships, 2) indirect relationships, and 3) correlations with BMI through the model with task- and ego-involving climate, competence, autonomy, relatedness, intrinsic motivation, enjoyment, knowledge,

performance, and total MVPA and in girls and boys (Figure 1). Based on the previously established associations, task-involving climate was expected to be positively linked with competence, autonomy, relatedness, intrinsic motivation, enjoyment, knowledge, performance, and MVPA. In turn, ego-involving climate was assumed to be unrelated or negatively related to enjoyment, knowledge, performance, and total MVPA through the sequence. Boys were expected to be more physically active than girls and students with higher BMI less active than students were with lower BMI.

Methods

Participants

Participants were 770 (397 girls, 373 boys) middle school students aged between 13- to 16-years (M = 13.99 ± .81 years) recruited from four public schools in three small towns located in North-East Finland. Study approval was obtained from the ethics committee of the local university. Permission to conduct the study was also obtained from all children and their parents. All students who returned signed forms were permitted to participate in the study. Forty percent of middle school students in the region participated in the study. Participants were ineligible if they had a medical condition or physical injuries as informed by parents and participants before the start of study. Participation was voluntary and no extra credit was awarded for participation.

Measures

Background Variables: Students provided details of their gender and grade in a structured response format. Height and weight were measured using digital equipment by the school nurses as a component of the annual health inspection provided to all students within the Finnish education system. A BMI score was calculated using a weight and height formula (kg/m^2).

Motivational Climate in PE: Perceptions of task- and ego-involving motivational climate in PE were measured using the Motivation Climate in PE Scale (MCPES; Soini et al., 2007). The individual item stem was "*In my PE class…*" The task-involving climate dimension consisted of five items (e.g. *It is important for students to try their best in PE classes*), and the ego-involving climate dimension included four items (e.g. *It is important for students to succeed better than others in PE classes*). Responses were indicated on a five-point Likert-scale ranging from *strongly disagree (1)* to *strongly agree (5)*. Recently, the confirmatory factor analysis (*TLI* = 0.96, *CFI* = 0.98, *RMSEA* = 0.059) and composite reliability (0.86) supported the construct validity of the scale for Finnish secondary school students (Gråstén, 2014).

Basic Psychological Needs Satisfaction: The Basic Needs Satisfaction Scale (BNSC; Deci et al., 2001) was administered to assess the satisfaction of competence, autonomy, and social relatedness in PE. The scale constitutes a 21-item questionnaire that includes the three subscales: competence (e.g. *I have been able to learn interesting new skills in PE*), relatedness (e.g. *I really like the students I exercise with in PE*), and autonomy (e.g. *I feel like I can make many inputs to deciding what to do in PE*). The original scale of Deci et al. (2001) measured needs satisfaction at work but Ntoumanis (2005) modified the scale to assess needs satisfaction in the PE context. All subscales were measured on five-point scales, *(1) totally disagree* to *(5) totally agree*. Ntoumanis (2005) reported that the modified model had a satisfactory model fit in British school students (*SRMR* = .06, *CFI* = .93, *RMSEA* = 0.06).

Motivational Regulation in PE: Contextual intrinsic motivation was measured using the Sport Motivation Scale (SMS; Pelletier et al., 1995) which was modified for the PE context. The measure consists of three subscales, comprising intrinsic motivation, extrinsic motivation, and amotivation. For the purpose of the current study, only the intrinsic motivation subscale (e.g. *For the pleasure I feel while improving some of my weak points*) was included. The scale consists of twelve items and has the item stem "*I'm currently participating in PE, because*?" Each item was rated on a five-point Likert-scale ranging from *strongly disagree (1)* to *strongly agree (5)*. Previously, the confirmatory factor analysis results (*TLI* = 0.89, *CFI* = 0.90, *RMSEA* = 0.058) and composite reliability (.90) provided by Gråstén (2014) supported the acceptable construct validity of the scale in a sample of Finnish secondary school students.

Affect (Enjoyment): Enjoyment in PE classes was assessed using the PE Enjoyment Scale (Soini et al., 2007). The item stem was "*In my PE class...*" The subscale consists of four items (e.g., *I enjoy PE classes*) and the responses were indicated on a five-point Likert-scale ranging from *strongly disagree (1)* to *strongly agree (5)*. Recently, the construct validity (*TLI* = 1.00, *CFI* = 1.00, *RMSEA* = 0.031) and composite reliability (0.93) of the scale were supported by results achieved using a sample of Finnish secondary school students (Gråstén, 2014).

Behavior (Performance): Performance in PE was measured using PE assessments. School administrators were consulted in order to gather students' PE assessments using the scale, failed (*4*) to excellent (*10*), approved by the Finnish National Board of Education (2004). Graded assessments represented students' overall performance in PE classes including cognitive (e.g. knowledge about the connections between exercise and health), social (e.g. compliance with the rules and fair play), and behavioral (e.g. effort in PE classes) aspects evaluated objectively by the PE teachers.

Cognition (Knowledge): Knowledge about the importance of PE for wellbeing and health was determined using the Self- and Task-Perception Questionnaire (STPQ), originally developed by Eccles et al. (1984). The scale was modified following procedures outlined by Xiang et al. (2003) to adapt the domain-specific questions for Finnish PE classes. The introduction preceding the items was "*When you think about your school PE classes*." Sum scores of two items (e.g. *How important is what you learn in PE classes?*) were used as values of knowledge. Responses were given on five-point Likert-scales anchored by *totally disagree (1)* and *totally agree (5)*. Gråstén (2014) demonstrated satisfactory model fit for the scale (*TLI* = 0.96, *CFI* = 0.97, *RMSEA* = 0.072) and excellent composite

reliability for importance of PE (0.97) using a sample of Finnish secondary school students.

Self-reported MVPA: Self-reported MVPA was examined using the Health Behavior in School-aged Children Research Protocol (Currie et al., 2002). The introduction preceding the items is: "*In the next two questions physical activity means all activities which raises your heart rates or momentarily get you out of breath for example in doing exercise, playing with your friends, going to school, or in school PE. Sport also includes for example jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball and baseball*." The items require students to summarize their time spent in MVPA each day in the following way: 1) "*When you think about your typical week, on how many days are you physically active for a total of at least* 60 *minutes per day*?" and 2) "*Over the past* 7 *days, on how many days were you physically active for a total of at least* 60 *minutes per day*?" Both items rated on an eight-point response scale (0 to 7 days). The mean score of the two items was used as students' MVPA score. Gråstén (2014) reported the MVPA items were reliable (α = 0.91) and had moderate correlation (.46) with the accelerometer data collected over a seven-day period for a sample of 96 Finnish Grade 7 to 9 students with a mean age of 15.3 years,.

Procedure

The present cross-sectional student data was collected using online questionnaires completed under the supervision of the class teachers during 45-minute classes in the computer labs. Health education lesson time was used for questionnaires, PE was provided as usual. The participants were advised to ask for help if unsure of either the instructions or the clarity of a particular item. To minimize the tendency to give socially desirable responses, children were encouraged to answer honestly and were assured that their responses were confidential. Participants were told that their involvement was voluntary and they were allowed to cease their participation at any time. The data was saved automatically into the database for later analysis by the researchers.

Statistical analyses

Normal distribution, outliers, and missing values were initially examined. Modifications due to non-normality or outliers were not required and a total 3.3% of missing values were identified. Specifically, missing values were detected in BMI, because 72 students did not provide this information. Little's MCAR -test (χ^2 = 1113.20, *df* = 850, p < 0.001) and frequencies indicated that the missing values were not systematic or representative of any particular study group or school. The missing values were assumed to be missing at random (MAR) (Little and Rubin, 2002).

Correlation coefficients, Cronbach alphas, means, and standard deviations were determined for each variable. In order to test the associations between motivational climate (task- and ego-involving climate), psychological needs (competence, autonomy, relatedness), intrinsic motivation, cognition (knowledge), behavior (performance), affect (enjoyment), and total MVPA, a path model was implemented. Indirect effects between motivational climate and contextual outcomes and MVPA were tested by setting basic needs and intrinsic motivation as mediators into the model. Gender differences were examined using two-group protocol by Muthén and Asparouhov (2002), in which two nested models can be tested by constraining subsequent parameters to be equal. Figure 1 presents the theorized Hierarchical Model of Motivation in PE. Correlations with overweight were tested by adding BMI into the model as a covariate.

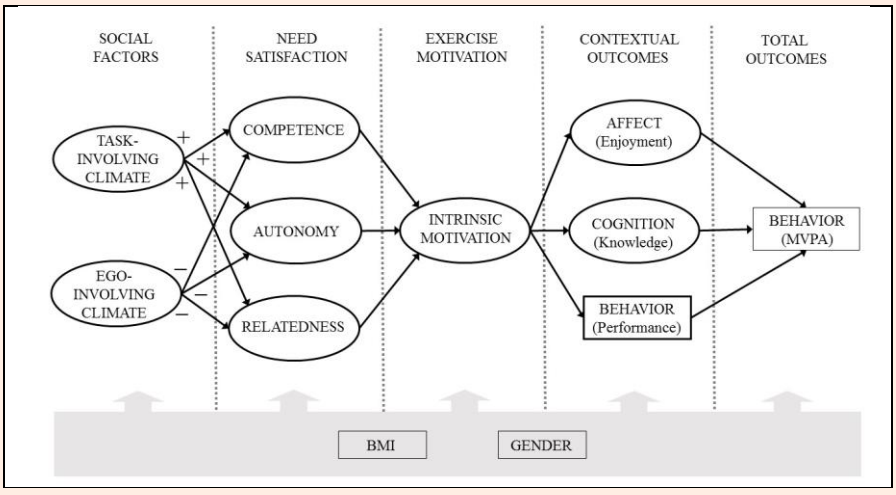

Figure 1. The theorized motivational model of physical education including BMI correlations and gender differences.

Table 1. Correlations, means, standard deviations, and Cronbach alphas of the study variables.

	1	2	3	4	5	6	7	8	9	10	11	M	SD	α
1Task-involving climate	-	.01	.45***	.58***	.47***	.62***	.67***	.46***	.41***	.22***	-.04	3.99	.69	.79
2 Ego-involving climate	.13*	-	-.08	-.04	-.08	.14**	-.01	.16**	.06	-.01	-.00	2.73	.95	.85
3 Competence	.34***	-.08	-	.51***	.53***	.46***	.54***	.51***	.57***	.28***	-.15**	3.54	.79	.74
4 Autonomy	.59***	.08	.48***	-	.72***	.45***	.60***	.37***	.43***	.22***	-.06	3.80	.68	.70

5 Relatedness	.49***	-.05	.62***	.67***	-	.36***	.52***	.30***	.40***	.12*	-.18**	4.17	.71	.84
6 Intrinsic motivation	.54***	.06	.46***	.61***	.49***	-	.59***	.56***	.44***	.22***	-.05	3.54	.81	.95
7 Enjoyment	.73***	.15**	.50***	.65***	.59***	.63***	-	.57***	.54***	.22***	-.02	3.66	1.02	.94
8 Knowledge	.44***	.10*	.55***	.56***	.47***	.72***	.63***	-	.51***	.19***	-.10*	3.42	1.01	.74
9 Performance	.45***	.13*	.42***	.32***	.30***	.33***	.48***	.42***	-	.28***	-.16**	8.20	.90	-
10 MVPA	.34***	.04	.32***	.29***	.21***	.38***	.31***	.41***	.43***	-	.01	4.16	1.76	.89
11 BMI	-.06	.01	-.08	-.02	-.01	.00	-.00	-.03	-.08	-.04	-	21.0	3.4	-
M	4.11	3.11	3.51	3.65	3.91	3.64	3.99	3.70	8.25	4.27	21.22			
SD	.81	.99	.82	.78	.74	.87	1.01	1.05	1.05	2.09	3.32			
α	.88	.80	.66	.73	.77	.95	.92	.82	-	.94	-			

Correlations for girls (n = 397) are presented above and for boys (n = 373) below the diagonal. M = Means, SD = standard deviations and α = Cronbach alphas for girls are presented in vertical columns and for boys in horizontal columns. ***p < 0.001, **p < 0.01, *p < 0.05.

Chi-square test (χ^2) was applied as a test of the model's overall goodness-of-fit. A non-significant difference between the observed frequency distribution and the theoretical distribution demonstrates an acceptable fit to the data. To determine the suitability of the model, the standardized root mean square residual (*SRMR*), the root mean square error of approximation (*RMSEA*), the comparative fit index (*CFI*), and the Tucker-Lewis index (*TLI*) were also examined. A value less than .06 for SRMR is generally considered as a good model fit and a value of 0.08 or less for the RMSEA indicate a reasonable error of approximate fit. For the CFI and TLI indices, values greater than .95 are indicative of an excellent model fit (Kline, 2005). The proportions of variance were analyzed using squared multiple correlations (R^2). The missing values, descriptive and correlational analyses were conducted using SPSS Version 22.0 and the structural equation with Mplus Version 7.11.

Results

Descriptive statistics

Correlation coefficients, Cronbach alphas, means, and standard deviations of the study variables are shown in Table 1. The results showed that the associations between variables ranged from weak negative to strong positive (-.18 to .73). The strongest positive correlations were found between task-involving climate and enjoyment in both girls and boys in addition to autonomy and relatedness among girls. The strongest negative association was detected between girls' perceived relatedness and BMI, which ranged from 11 to 33 among girls and from 15 to 46 among boys. Girls' graded PE assessments varied between 5 and 10 (36% had 9 or 10) and the boys' assessments from 4 to 10 (41% had 9 or 10).

Confirmatory factor analysis

All scales have previously been validated for Finnish school students with the exception of the Basic Needs Satisfaction Scale. A confirmatory factors analysis was implemented to test factor structure of the scale. The original scale showed a poor model fit for the data ($\chi^2(189) = 1943.504$, $p < 0.001$, $CFI = 0.63$, $TLI = 0.58$, $RMSEA = 0.112$, $SRMR = 0.127$). Similarly to Ntoumanis (2005), after removing all negative items, the modified model showed acceptable model fit indices for the data ($\chi^2(51) = 192.506$, $p < 0.001$, $CFI = 0.95$, $TLI = 0.93$, $RMSEA = 0.061$, $SRMR = 0.035$). On this basis, the subscale provided sufficiently reliable results for the current path model development.

Motivational model of PE

To test the associations between task- and ego-involving motivational climate, competence, autonomy, relatedness, intrinsic motivation, enjoyment, knowledge, performance, and total MVPA, a path model was implemented. The model including gender grouping and correlations among psychological needs and contextual outcomes revealed an excellent model fit for the data (Table 2).

For girls, the model revealed positive direct effects from task-involving climate to competence, autonomy, relatedness, intrinsic motivation, enjoyment, and knowledge (Table 2). Ego-involving climate associated positively with intrinsic motivation and PE enjoyment. Physical competence was positively related with intrinsic motivation, enjoyment, knowledge, performance, and total MVPA and autonomy with enjoyment. A negative direct path was found between relatedness and total MVPA. Intrinsic motivation had positive relations with enjoyment, knowledge, and performance. BMI was negatively linked with relatedness and competence. Square multiple correlations revealed that the strength between the independent and depend variables was strongest in enjoyment and lowest in total MVPA variables. Finally, four significant indirect paths from task-involving climate through competence to intrinsic motivation and further to enjoyment, knowledge, and performance were detected (Table 3).

For boys, the model for revealed positive direct effects from task-involving climate to competence, autonomy, relatedness, intrinsic motivation, enjoyment, and performance, and total MVPA (Table 2). In addition, negative direct paths from ego-involving climate to competence and relatedness and positive paths to enjoyment, knowledge, and performance were found. Competence had positive relationships with intrinsic motivation, enjoyment, knowledge, and performance. Autonomy related with intrinsic motivation, enjoyment, and knowledge, whereas relatedness associated only with enjoyment. Intrinsic motivation had positive direct paths to enjoyment, knowledge, and total MVPA. Square multiple correlations were strongest in enjoyment and lowest in the competence variables. In total, seven significant indirect paths from task-involving climate via competence or autonomy to intrinsic motivation, enjoyment, knowledge, and total MVPA were detected (Table 3).

Two-group tests revealed significant gender differences in the intercepts of total MVPA ($p < 0.05$) and relatedness ($p < 0.05$) with boys being more physically active than girls, and in contrast, girls reporting higher

relatedness in PE than boys. In addition, two-group tests showed greater variability among boys than girls in task-involving climate ($p < 0.05$), autonomy ($p < 0.05$), competence ($p < 0.05$), and performance ($p < 0.001$), whereas girls had greater variability than boys in enjoyment ($p < .05$) and knowledge ($p < 0.05$) variables.

Table 3. Indirect paths of physical education motivational model for girls and boys.

♀ (n = 397)	Standardized estimate
Task → Com → IM → Enj	.02(.01)**
Task → Com → IM → Know	.03(.01)**
Task → Com → IM → Perf	.03(.01)**
Task → Com → IM	.10(.03)***

♂ (n = 373)	
Task → Aut → IM → Know → MVPA	.02(.01)*
Task → Com → IM → Enj	.01(.01)*
Task → Aut → IM → Enj	.04(.01)**
Task → Com → IM → Know	.04(.02)**
Task → Aut → IM → Know	.11(.02)***
Task → Com → IM	.07(.03)**
Task → Aut → IM	.21(.05)***

Task = task-involving climate, Com = competence, Aut = autonomy, IM = intrinsic motivation, Enj = enjoyment, Know = knowledge, Perf = performance (graded assessments), MVPA = moderate to vigorous physical activity. *** p < 0.001, ** p < 0.01, * p < 0.05. Standard errors in parentheses.

Table 2. Regression coefficients, correlation coefficients, squared multiple correlations, and model fit indices for the path model.

	Gender	Task	Ego	Com	Aut	Rel	IM	Enj	Know	Perf	MVPA
Regression coefficients											
Task →	♀			.45(.04)***	.58(.04)***	.47(.04)***	.49(.05)***	.33(.05)***	13(.06)*	.07(.07)	.06(.08)
	♂			.35(.05)***	.59(.04)***	.50(.04)***	.26(.06)***	.45(.06)***	-.01(.05)	.36(.08)***	.17(.08)*
Ego →	♀			-.09(.05)	-.04(.04)	-.09(.05)	.15(.04)***	-.02(.04)	.14(.04)**	.08(.04)	-.02(.05)
	♂			-.12(.06)*	.00(.05)	-.11(.05)*	.01(.05)	.08(.03)*	.08(.04)*	.11(.05)*	-.02(.05)
Com →	♀						.23(.05)***	.18(.05)***	.33(.05)***	.40(.05)***	.19(.07)***
	♂						.22(.06)**	.14(.05)**	.28(.06)***	.37(.05)***	.10(.07)
Aut →	♀						.08(.07)	.17(.06)**	.03(.07)	.10(.07)	.15(.08)
	♂						.36(.08)***	.13(.05)*	.13(.06)*	-.04(.07)	.03(.07)
Rel →	♀						-.04(.06)	.08(.05)	-.06(.06)	.02(.06)	-.17(.08)*
	♂						-.08(.07)	.11(.05)*	-.04(.07)	-.08(.07)	-.11(.07)
IM →	♀							.21(.05)***	.32(.07)***	.15(.06)*	.06(.07)
	♂							.19(.04)***	.53(.06)***	.02(.07)	.17(.07)*
Enj →	♀										-.03(.08)
	♂										-.18(.09)
Know →	♀										-.03(.06)
	♂										.19(.07)*
Perf →	♀										.16(06)**
	♂										.29(.06)***
BMI →	♀	-.04(.05)	-.00(.05)	-.13(.05)**	-.03(.04)	-.16(.05)**	.01(.04)	.06(.04)	-.03(.05)	-.08(.04)	.04(.05)
	♂	-.06(.06)	.01(.05)	-.05(.04)	.02(.04)	.02(.04)	.04(.05)	.04(.03)	-.01(.04)	-.03(.04)	.01(.04)
Correlation coefficients											
Com ↔	♀				.34(.05)***	.38(.04)***					
	♂				.38(.04)***	.55(.04)***					
Aut ↔	♀					.62(.04)***					
	♂					.54(.05)***					
Enj ↔	♀								.27(.06)***	.24(.05)***	
	♂								.24(.05)***	.16(.07)*	
Know ↔	♀									.21(.05)***	
	♂									.17(.06)**	
Squared multiple correlations											
R^2	♀			.23(.04)***	.34(.04)***	.26(.04)***	.45(.04)***	.58(.03)***	.42(.04)***	.39(.04)***	.13(.03)***
	♂			.14(.04)***	.35(.05)***	.27(.05)***	.46(.05)***	.67(.03)***	.59(.04)***	.30(.05)***	.29(.04)***
Model fit											
$\chi^2(2) = 4.630$, p = .099, CFI = 1.00, TLI = .95, RMSEA = .058, SRMR = .019											

Task = task-involving climate, Ego = ego-involving climate, Com = competence, Aut = autonomy, Rel = relatedness, IM = intrinsic motivation, Enj = enjoyment, Know = knowledge, Perf = performance (graded assessments), BMI = body mass index, MVPA = moderate to vigorous physical activity. *** p < 0.001, ** p < 0.01, * p < 0.05. Standard errors in parentheses.

Discussion

The present study was the first to test the full sequence of the Hierarchical Model of Motivation including the associations between social factors, psychological needs, exercise motivation, contextual enjoyment, knowledge, performance, and total MVPA. The key findings supported the theorized model, since girls' perceived task-involving climate mediated by physical competence and intrinsic motivation positively related to enjoyment, knowledge, and performance, whereas boys' perceived task-involving climate associated with total MVPA via autonomy, intrinsic motivation, and knowledge. The results showed that perceptions of an ego-involving climate in PE had weak relationships to these outcomes in both girls and boys. BMI was linked with competence and relatedness only among girls.

The present positive direct effects in both girls and boys were in line with the previously established relations between task-involving climate and physical competence (Gråstén et al., 2012), autonomy (Soini et al., 2007), relatedness (Soini et al., 2007), intrinsic motivation (Yli-Piipari, 2011), importance of PE (Gråstén, 2016), PE enjoyment (Barkoukis et al., 2008; Gråstén et al., 2012), and PE behavior (Braithwaite et al., 2011). A somewhat surprising result was that girls' perceptions of task-involving climate were linked with neither performance in PE nor total MVPA, although previous studies have reported similar associations in girls (Bowler, 2009; Braithwaite et al., 2011). None of the previous studies assessed the relationship between task-involving climate and student performance across participation in conventional PE classes. For instance, Barkoukis, Tsorbatzoudis, and Grouios (2008) reported that Greek middle school students perceived higher enjoyment and competence after the seven-month intervention based on task-involving motivational teaching practices. In their intervention, students participated in classes at their own skill level (e.g., shooting in basketball from different distances) and selected their own teammates and led activities. In contrast, the present study adopted all cognitive, affective, and behavioral outcomes in order to examine the relationships between the variables across conventional PE classes. In any case, task-involving teaching practices showed to be feasible to use in PE classes for both cohorts of girls and boys. Therefore, the present results provide important insights into motivational processes across conventional PE classes without any specific intervention design.

The findings also revealed that girls' perceived ego-involving climate associated positively with intrinsic motivation and knowledge, whereas positive direct paths were found from boys' ego-involving climate to enjoyment, knowledge, and performance and a negative path between ego-involving climate and relatedness. However, all relationships were relatively weak, and thus, consistent with the previously established relationships (Gråstén et al., 2012; 2015). An unforeseen result was that ego-involving climate positively related to girls' intrinsic motivation, boys' PE enjoyment and performance, and knowledge in both girls and boys, therefore contrasting the assumuption that the ego-involving climate might be unrelated or negatively related to students' cognitive, affective, and behavioral outcomes. This finding indicated that both task-involving and ego-involving motivational climates may be needed in order to achieve the different objectives of school PE (Finnish National Board of Education, 2004). Perhaps, task- and ego-involving dimensions are crucial for a range of personality types, in other words, different children depend on a variety of teaching methods. It is important to note that although many students are motivated to participate in PE classes, there are children who suffer from a lack of motivation to participate (Ntoumanis et al., 2004). Because the different contextual outcomes of enjoyment, knowledge, and performance were related with either task- or ego-involving climate, it is essential that school PE continues to provide opportunities to all students to learn new skills and to be physically active by using a broad range of teaching methods. In doing so, motivation associated with engagement in exercise during PE may be transferred to motivation to engage in leisure time physical activities (Hagger, 2014).

Previous PE studies have found competence to be the strongest predictor of intrinsic motivation in comparison to autonomy and relatedness (Standage et al., 2005; Taylor et al., 2010). Based on these findings, it was not unanticipated that physical competence was the most important psychological need in terms of intrinsic motivation in the current study. Specifically, the model highlighted that perceived physical competence was positively related to intrinsic motivation, enjoyment, knowledge, and performance in both girls and boys, and total MVPA for girls, whereas autonomy was linked to only girls' enjoyment and boys' enjoyment and knowledge. This finding was supported by a qualitative study involving adolescents, which found that motivation towards participation in physical activity is affected by perceptions of competence (Barnett et al., 2013). Hence, enhancing students' perceived physical competence should remain as a necessary goal within PE classes.

A negative path between girls' perceived relatedness and total MVPA was detected indicating that the higher perceived social relatedness, the lower perceptions of MVPA. Standage et al., (2005) suggested that students might engage in physical activities, because they want to avoid being isolated from a group. Second, Brener et al. (2003) assumed that youth may purposely under-report or over-report some health and well-being behaviors, because they believe engaging in these behaviors is socially undesirable or desirable. Although peer groups clearly have the potential to impact on students' motivation, it is possible that puberty plays a major, but still unknown, role on their perceptions of social relatedness in school PE and MVPA engagement.

Furthermore, the results showed that intrinsic motivation had a positive path with girls' PE enjoyment, knowledge, and performance, whereas boys' intrinsic motivation related to enjoyment, knowledge, and total MVPA. This result reinforces that intrinsic motivation is typically related to different types of contextual outcomes in PE classes. Although intrinsic motivation has been considered a preferred psychological attribute for PE, it is not always possible to support this motivational characteristic in each and every situation. Although, the qualitative study of Barnett et al. (2013) recommended that we provide PE options that fit with adolescents who have intrinsic achievement motivations, in some cases, students have no internal desire to engage in an activity. Organized physical activity can be conducted in a way that incorporates personal motivations, for instance by encouraging students to "achieve personal bests". Based on the current and previous findings, enhancing intrinsic motivation can be a useful way of driving different cognitive, affective, or behavioral outcomes in PE.

Additionally, PE performances based on graded assessments were positively connected with total MVPA in both girls and boys. Similarly, Ruch et al. (2012) found that children who were more active during PE classes were

more active over the day. As such, promoting physical activity performance in PE classes is important in order to support students to achieve sufficient physical activity on a daily basis. However, it must be acknowledged that school PE classes are not limited to physical training activities or skill development, but also knowledge, rules, fair play, respect, tactics, bodily and social awareness, and personal interaction linked to social effort (European Commission, 2013). Thereby, the contribution of physical activity in PE to total daily physical activity cannot be seen as a fundamental objective for school PE. Graded assessments appeared to be essential in motivating students to participate in greater total MVPA.

The indirect paths from girls' perceived task-involving climate via physical competence and intrinsic motivation to enjoyment, knowledge, and performance, in addition to indirect paths from boys' perceived task-involving climate through autonomy, intrinsic motivation, and knowledge to total MVPA were revealed. Gender variation in terms of different indirect paths is difficult to evaluate without any additional information. Physical competence seemed to be important for both girls and boys, and autonomy only for boys. Despite, indirect paths of girls and boys associated with different contextual outcomes and girls' paths were not related with total MVPA at all. This infers that girls and boys perceive PE classes in a different way. Recent literature reviews further highlight that it is difficult to make any definitive conclusions about what constitutes effective PE classes as there was a lack of studies targeting contextual outcomes in PE (Dudley et al., 2011; Ntoumanis, 2005). Taken together, the results supported the existing motivational model of Vallerand (Vallerand and Lalande, 2011) in which social factors mediated by psychological attributes related to contextual consequences in the PE.

Finally, the current results showed that boys were more physically active than girls were, and in contrast, girls reported higher relatedness in PE than boys did. In addition, boys had greater variability than girls in task-involving climate, autonomy, competence, and performance, whereas girls had greater variability than boys had in enjoyment and knowledge variables. These gender differences were mainly as expected. The present study, however, did not show differences between girls and boys in the levels of physical competence (Fairclough, 2003), autonomy (Soini et al., 2007), intrinsic motivation (Yli-Piipari, 2011), although gender differences have previously been reported in favor of boys. It has to be noted that individual variation was large in most variables, therefore, it is difficult to make further conclusions without additional information, especially regarding psychological factors. In contrast, an interesting finding was that BMI was negatively connected with physical competence and social relatedness only among girls. This result infers the higher BMI girls had lower perceptions of competence and relatedness in PE. Craft, Pleiffer, and Pivarnik (2003) determined that girls' physical appearance and peer acceptance strongly related to girls' physical competence in physical activity, and larger girls may be at risk of low perceptions of physical competence. Since physical development and bodily changes in adolescence appear to be associated with negative perceptions of physical competence and social relatedness, enhancing competence among adolescent girls may be accomplished by emphasizing friendship and social interaction in PE classes (Craft, Pleiffer, & Pivarnik, 2003).

Limitations and Future Directions

First, the current study was cross-sectional, and therefore, the links identified should not be interpreted as cause and effect. Second, outcome variables excluding graded PE performance were measured using self-reports. The truthfulness and accuracy of self-reports may be compromised, because some health and well-being behaviors are difficult to recall and may also be so sensitive that respondents are reluctant to provide exact details (Brener et al., 2003).

Future studies could include students' perceptions of teaching practices using several methods in order to standardize the practices as accurately as possible. Although this study focused on intrinsic motivation as the most essential dimension of exercise motivation (Deci and Ryan, 2017), extrinsic motivation and amotivation could be included into the future motivational models of PE. Gender groups versus mixed groups in PE could also be examined in order to assess physical activity in PE. In line with the proposal of Ntoumanis (2005), more studies with larger number of contextual units are still needed, as cognitions as contextual outcomes are largely unknown. This reinforces the potential for substantial methodological variation to be introduced in the literature regarding cognitive outcomes in PE settings.

Conclusion

The findings of the current study supported the structures of a Hierarchical Model of Motivation in the PE context. Indirect paths for girls and boys associated with different contextual outcomes and girls' motivational sequence was not related with total MVPA at all. This may possibly indicate that girls and boys perceive PE classes in a different way. This adds to the literature in this area, since a recent review highlighted that there was a lack of studies targeting contextual outcomes in PE. Although, the current and previous practical findings reinforced that school PE could be most effective if based on task-involving motivational climate, in some cases, ego-involving climates should not be totally avoided. External motivators can help students to feel more competent in the classes, thus enhancing intrinsic motivation (Plotnik & Kouyoumjian, 2011). For instance, graded PE assessments appeared to be important for greater total MVPA participation. An unexpected finding was that BMI was linked with competence and relatedness only among girls, although, since both girls and boys with high BMI have previously been reported lower perceptions of physical competence (Carissimi et al., 2017). Most Finnish schools have gender groups in PE, girls are taught by the female teachers and boys by the male teachers. Cultural variations or teaching practices may be the reason for differences between previous and current findings. Since physical development and bodily changes in adolescence appear to

be associated with negative perceptions of physical competence and social relatedness, enhancing competence among adolescent girls may be accomplished by emphasizing social interaction in PE classes.

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Key points

- The present findings indicated that girls and boys perceive PE classes in a different way.
- Graded PE assessments appeared to be essential in motivating both girls and boys to participate in greater total MVPA, whereas BMI was negatively linked with competence and social relatedness only among girls.
- Although, the current and previous empirical findings supported task-involving teaching methods in PE, in some cases, ego-involving climate should be considered. Both task- and ego-involving teaching practices can be useful ways of developing preferred behaviors in PE classes.

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